

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application for:
ADA Environmental Solutions, LLC

Art Unit: 3749

First Named Inventor: Johnson, et al.

Examiner: Rinehart, Kenneth

Appln. No.: 10/622,677

Confirmation No.: 3654

Filing Date: July 18, 2003

Atty. Docket No. 3791-13-CON

For: "LOW SULFUR COAL ADDITIVE FOR
IMPROVED FURNACE OPERATION"

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APPELLANTS' REPLY BRIEF
(37 CFR § 41.37)

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant submits this Reply Brief in response to the Examiner's Answer mailed June 20, 2010, in connection with the appeal under 37 CFR§1.191 to the Board of Patent Appeals and Interferences of the United States Patent and Trademark Office from the final rejection of claims 24-26, 33-34, 36, 44-53, 55, 56, 61-66, 68-74, 76-77, 82-88, 90-96, 98-99, 104-110, 112-118, 120-121, 126-132, 134-137, and 139-141, of the above-identified patent application. Although Appellant believes that no fees are associated with this appeal, please charge any such fees to Deposit Account No. 19-1970. The structure of the Brief is as follows in accordance with 37 CFR §1.192(c):

- I. Status of Claims.
- II. Status of Amendments.
- III. Grounds of Rejection to be Reviewed on Appeal.
- III. Arguments - Rejections under 35 U.S.C. §112, First Paragraph.
- IV. Arguments – Rejections under 35 U.S.C. §103.

I. STATUS OF CLAIMS.

Claims 24-26, 33-34, 36, 44-66, 68-88, 90-110, 112-132, 134-137, and 139-141 are currently pending. Claims 1-23, 27-32, 35, 37-43, 67, 89, 111, 133, 138, and 142 have been canceled. Accordingly, claims 24-26, 33-34, 36, 44-66, 68-88, 90-110, 112-132, 134-137, and 139-141 are being appealed.

Claims 24-26, 33-34, 36, 44-66, 73, 78-81, 87-88, 95, 100-102, 109-110, 122-124, 131-132, and 140-141 stand rejected under 35 U.S.C. §112, first paragraph.

Claims 24-26, 33-34, 36, 44-53, 55, 56, 61-66, 68-74, 76-77, 82-88, 90-96, 98-99, 104-110, 112-118, 120-121, 126-132, 134-137, and 139-141 stand rejected under 35 U.S.C. §103(a).

The Claims at issue (i.e., Claims 104-145) are set forth in the CLAIMS APPENDIX attached to Appellant's Brief.

II. STATUS OF AMENDMENTS.

All amendments made by Applicants have been entered by the Examiner. The most recent amendments made on October 27, 2008, in response to a non-final Office Action mailed on June 26, 2008, were entered and considered by the Examiner in the final Office Action dated November 17, 2008.

III. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL.

Whether Claims 24-26, 33-34, 36, 44-66, 73, 78-81, 87-88, 95, 100-102, 109-110, 122-124, 131-132, and 140-141 comply with 35 U.S.C. §112, first paragraph..

Whether Claims 24-26, 33-34, 36, 44-53, 55-56, 61-66, 68-74, 76-77, 82-88, 90-96, 98-99, 104-110, 112-118, 120-121, 126-132, 134-137, and 139-141 are patentable under 35 U.S.C. §103(a) based on U.S. 1,955,574 to Benner in view of U.S. 4,572,085 to Hepworth.

Whether Claims 57-58, 78-79, 100-101, and 122-123 are patentable under 35 U.S.C. §103(a) based on Benner in view of Hepworth and further in view of U.S. 4,886,521 to Khan.

Whether Claims 59-60, 80-81, 102-103, and 124-125 are patentable under 35 U.S.C. §103(a) based on Benner in view of Hepworth and further in view of U.S. 3,896,746 to Pirsh.

Whether Claims 54, 75, 97, and 119 are patentable under 35 U.S.C. §103(a) based on Benner in view of Hepworth and further in view of U.S. 4,089,507 to Arai, et al.

Whether Claims 68-86, 89-108, 111-130, and 133-139 are patentable under 35 U.S.C. §103(a) based on Hepworth in view of U.S. 4,498,402 to Kober, et al.

IV. ARGUMENTS – REJECTIONS OF CLAIMS 24-26, 33-34, 36, 44-66, 73, 78-81, 87-88, 95, 100-102, 109-110, 122-124, 131-132, AND 140-141 UNDER 35 U.S.C. SECTION 112, FIRST PARAGRAPH

A. Overview of the Issue.

Before responding to the arguments of the Examiner, it is important to understand what terms are at issue in independent claim 24. Independent claim 24 includes two alternatives. Alternative (i) requires the ash slag to have a fluid temperature less than a fluid temperature characteristic of the ash slag produced from combustion of the solid fuel alone. Alternative (ii) requires the ash slag to have a melting point less than a melting point characteristic of the ash slag produced from combustion of the solid fuel alone. The only part of independent claim 24 at issue under 35 U.S.C. §112, first paragraph, is alternative (i).

Regarding support in Applicant's specification for alternative (i), Applicant relies on the following passages:

The iron-containing additive can be in any form and any composition so long as iron is present in sufficient amounts to *flux* effectively the feed material. The iron can be present in any form(s) that *fluxes* under the conditions of the furnace, including in the forms of ferrous or ferric oxides and sulfides.

(Specification at page 6, lines 19-22. (Emphasis supplied.)) *See also id.* at page 5, lines 13-17 ("The various methods and compositions of the present invention can provide a *fluxing agent* or additive that can be contacted with the coal feed to or in a combustion chamber of a furnace to produce a slag layer having one or more desirable characteristics, *such as viscosity and*

thickness.") (Emphasis supplied.); and page 8, lines 9-10 ("Such pellets take longer to heat and therefore *melt* and act as a *flux*.") (Emphasis supplied.).

While not wishing to be bound by any theory, it is believed that the presence of iron in the calcium aluminosilicate slags of western coals causes a decrease in the melting temperature of the ash and crystal formation in the melt when a critical temperature (T_{CV}) is reached. These crystals change the flow characteristics of the slag causing the slag to thicken before the slag can flow. This phenomenon is known as "yield stress" and is familiar to those skilled in the art of non-Newtonian flow. Thicker slag allows the slag to capture and hold more coal particles. Therefore, fewer coal particles escape the combustor without being burned.

(*Id.* at page 7, lines 15-22. (Emphasis supplied.))

In the Experimental section at pages 18-20, the slag viscosity of a cyclone furnace was modeled and used to compare the effects of the additive (namely BOF flue dust) on molten ash or ash slag viscosity with and without the additive present. It was established that the temperature at which the molten ash would have a viscosity of 250 poise (the T_{250} temperature) was reduced by at least 100°F, which is an important indicator of the minimum temperature at which the ash slag will flow. Figure 7 further shows the temperature and viscosity data for a typical ash slag alone (shown as "No Additive") compared to the same ash slag treated by the additive. The fluxed ash slag flows at a lower temperature. Figure 8 further illustrates the viscosity-temperature relationship of ash slag alone (shown as "Coffeen (rd.)") versus in the presence of 2% of the additive (shown as "Coffeen + ADA 249 (rd.)"). Figure 8 shows that the fluxed ash slag shown by the curve "Coffeen + ADA 249 (rd.)", for a given temperature, has a lower viscosity than the unfluxed ash slag shown by the curve "Coffeen (rd.)".

Applicant further notifies the Board of an error in the Exhibits to the Appellant's Brief. The originally filed Appellant's Brief (filed April 13, 2009) includes all of the proper Exhibits 1-5. The corrected Appellant's Brief (filed June 26, 2009) contains an incorrect set of Exhibits 1-5. Accordingly, Applicant requests the Board to use the set of Exhibits in Appellant's Brief filed April 13, 2009.

B. The Examiner does not dispute that U.S. 6,484,651 to Shepard, Jr., (the patent from which alternative (i) was copied and attached to the Appeal Brief as Exhibit "3", when

compared to the requirements of claim 24 and the present specification, uses the same reactants under the same reaction conditions in the same reactor to produce inherently the same result, namely the production of an ash slag having a lower viscosity, ash melting temperature, and fluid temperature produced by combustion of coal alone. (Appeal Brief at pages 14-15.)

The fuel is a low sulfur western or eastern coal. The combustion chamber is a “slag tap” or “wet bottom” boiler, such as a cyclone-type boiler. The iron-bearing material is mill scale from steel production or dust from blast furnace gas cleaning equipment (“BOF dust”). The temperature regime is that necessary to combust the solid fuel and melt the ash content of the fuel to form ash slag. Regarding the results from adding the iron-bearing material, Shepard, et al., and the subject application both teach that the iron-bearing material fluxes the ash formed from the solid fuel, thereby causing the ash slag to have a lower viscosity than a slag produced by combustion of the coal alone. This is the objective of both the presently claimed invention and Shepard, et al. Both seek to combust low sulfur coals in slag tap or wet bottom boilers (which are designed to combust high sulfur coals) by modifying the ash slag viscosity through the use of a flux, namely mill scale or BOF dust.

C. The Examiner does not rebut Applicant’s argument that the first alternative is supported by the disclosure in the specification that the additive reduces ash viscosity compared to ash viscosity in the absence of the additive. Because the temperatures determined by the ash fusion test (which include the fusion temperature) reflect various stages of ash melting and therefore indicate a temperature associated with various levels of ash viscosity, it necessarily follows that a reduction in ash viscosity will have a concomitant reduction in fusion temperature. (Appeal Brief at pages 17-19.)

As noted by Niessen, the Ash Fusion Temperature Test Temperatures are:

Initial Deformation Temperature (IDT), where the tip of a cone, formed from the ash, just shows deformation;

Softening Temperature (ST), where the cone is slumped such that the height and width of the ash mass are equal;

Hemispherical Temperature (HT), where the mass is fluid but, due to surface tension, has a hemispherical shape with a height equal to one-half of the width; and

Fluid Temperature (FT), where the *molten* ash viscosity is very low and the material flows down the plate with a thickness not greater than 1/16 in (0.15 cm).

"Steam its generation and use", published by Babcock & Wilcox Company (1992) likewise defines "fluid temperature" as the temperature at which the ash cone has *molten* to a nearly flat layer having a specified height. (Emphasis supplied.) (*See also* Declaration of Ramon Bisque under 37 CFR§1.132 at ¶ 14 ("Bisque Declaration").)

As noted by Rod Hatt, *"Coal Properties, Sampling & Ash Characteristics"* at pages 4-5, "[t]he remaining fusion temperatures represent an ever increasing amount of molten material, and a lowering of the viscosity of the glass like material." (Emphasis supplied.)

D. The Examiner does not rebut Applicant's argument that the specification's use of the terms "flux" and "fluxing agent" conveys to one of ordinary skill in the art that the ash melting temperature or fluid temperature is lowered by the iron-bearing additive. (Appeal Brief at pages 17-19.)

E. The Examiner's own references support Applicant's position that one of ordinary skill in the art would believe ash fusion temperature and ash melting temperature to be synonymous.

The Examiner, based on Niessen, states that ash fusion temperature and ash melting temperature are "two different terms".

The synonymy of ash melting temperature and fusion temperature is illustrated by a side-by-side comparison of the ash melting point definition of Benner and ash fusion temperature definition of Niessen. On the one hand, U.S. 1,955,574 to Benner. Benner defines the "melting point" of the ash to be "the temperature at which it will prevent accumulation of [molten] slag on the furnace walls beyond a skin or coating which has been formed over the walls . . ." The Examiner does not dispute this definition. According to the Examiner, "[t]his passage can be taken on its face for its meaning [definition of ash melting point]." (Examiner's Answer at page

12.) On the other hand, Niessen defines fusion temperature as the temperature “where the molten ash viscosity is very low and the material flows down the plate with a thickness not greater than 1/16 in (0.15 cm).” (Emphasis supplied.) Applicant has studied carefully the two definitions and can discern no meaningful difference. In fact, one of ordinary skill in the art would consider a molten slag thickness of 1/16th inch to be melted.

F. Even if the Examiner is correct that ash melting temperature and fluid temperature are not synonymous, both melting and fluid temperatures reflect nearly identical degrees of ash melting and therefore are ash melting properties that would both be reduced by the iron-containing additive.

Applicant and the Examiner are in agreement on certain points. First, Niessen, which has been cited by the Examiner, states that “fluid temperature” is “where the molten ash viscosity is very low and the material flows down the plate with a thickness not greater than 1/16th.” “Molten” is defined as “melted or liquefied by heat.” *Webster’s New World Dictionary* (2nd Ed.). Applicant and the Examiner further agree that ash is multi-constituent, with each constituent having a separate melting point. (Babcock & Wilcox, “*Steam/its generation and use*”, (1972) at page 20-6; *see also* Bisque Declaration at ¶15.) The Ash Fusion Temperature Test (“AFT”) temperatures attempt to characterize the ash by its melting characteristics. (Babcock & Wilcox at pages 20-5 through 20-7; Bisque Declaration at ¶14.) Finally, Applicant and the Examiner agree that “the [melting] process [used to determine the AFT temperatures] continues until the temperature is higher than the melting point of most of the ash constituents and the fluid stage [or the fluid temperature] is reached.” (Babcock & Wilcox at page 20-6; Bisque Declaration at ¶ 15.)

From these points of agreement, it is readily obvious that ash fluid temperature and ash melting temperature, even if different properties, simply reflect different degrees of nearly complete ash melting. As both reflect nearly complete ash melting, they will be influenced, in like manner, by an iron-containing additive. The fluxing behavior of iron on slag is well known. Babcock & Wilcox note that iron, in its completely oxidized form (Fe₂O₃), tends to raise all four values of ash fusion temperatures, namely initial deformation, softening, hemispherical, and

fluid, while in the lesser oxidized form (FeO) it tends to lower all four of these values. (*Id.* at Chapter 15, page 15-5.) Hatt, *Coal Properties, Sampling & Ash Characteristics* agrees by stating that “[r]educed iron lowers melting and fusion temperatures of ash much better than the oxidized form.” (*Id.* at page 5.)

Accordingly, the specification provides ample support, either literally or under the doctrine of inherency, for the first alternative in independent claim 24.

V. ARGUMENTS – REJECTIONS OF CLAIMS 24-26, 33-34, 36, 44-53, 55-56, 61-66, 68-74, 76-77, 82-88, 90-96, 98-99, 104-110, 112-118, 120-121, 126-132, 134-137, AND 139-141 UNDER 35 U.S.C. §103(a) BASED ON U.S. 1,955,574 TO BENNER IN VIEW OF U.S. 4,572,085 TO HEPWORTH.

A. Benner’s teaching that iron oxides change ash melting point would not predict to one of ordinary skill in the art that the claimed mill scale or BOF dust would lower the melting and fluid temperatures.

First, Benner states that whether or not iron oxide changes the melting point of the ash depends on the oxidizing and reducing conditions in the combustion chamber and the amount of carbon in the ash. (Lines 41-46 and 50-57.)

Second, Benner does not state *how* the various forms of iron oxide change the melting point of the ash, namely it fails to state whether, and under what conditions, the various forms of iron oxide increase or decrease the melting point of the ash.

Third, Benner does not state what form of iron oxide changes the melting point of the ash. As noted, the degree of oxidation or reduction of the iron oxide dramatically influences its behavior on ash melting point and viscosity.

Fourth, Benner makes no mention of mill scale or BOF dust.

Fifth, Benner says nothing about whether or how the claimed mill scale or BOF dust will influence ash melting characteristics. Mill scale is formed on the outer surfaces of plates, sheets or profiles when they are being produced by rolling red hot iron or steel billets in rolling or steel mills. Mill scale typically contains a variety of iron oxides, including magnetite, hematite, wustite, alloying metals, such as aluminum, chromium, and nickel, silica, alumina, sulfur,

calcium oxide, and phosphorus. (Specification at page 6, line 19, to page 20, line 14; page 8, line 12, to page 9, line 3; page 11, line 7, to page 8, line 2; page 8, lines 7-19; and page 15, line 11, to page 16, line 2.) BOF dust are particles collected by particulate collection systems from off-gases of steel or iron manufacturing. BOF dust typically includes a variety of iron oxides, such as hematite, magnetite, wustite, and metallic iron, zinc oxide, silica, alumina, calcium oxide, magnesium oxide, carbon, sulfur, and oils and greases. *Id.* As noted, above, the effect of iron oxide on ash fusion temperatures and ash melting temperature depends on the degree of oxidation or reduction of the iron. In addition, it is not clear from Benner how the other constituents of mill scale and BOF dust would impact the ash fusion temperatures or ash melting temperature.

For at least these reasons, it would not be obvious to one of ordinary skill in the art, based on Benner, that mill scale or BOF dust would impact ash fusion temperatures or ash melting temperature let alone how they would be impacted.

B. As admitted by the Examiner, Hepworth fails to overcome the deficiencies of Benner.

The Examiner does not dispute that Hepworth teaches adding taconite and mill scale to control sulfur oxide emissions and says nothing about its impact on melting or fluid temperatures.

C. As admitted by the Examiner, Khan fails to overcome the deficiencies of Benner.

The Examiner does not dispute that Khan says nothing about its impact on melting or fluid temperatures.

D. As admitted by the Examiner, Pirsch fails to overcome the deficiencies of Benner.

The Examiner does not dispute that Pirsch says nothing about its impact on melting or fluid temperatures.

E. As admitted by the Examiner, Arai, et al., fail to overcome the deficiencies of Benner.

The Examiner does not dispute that Arai, et al., say nothing about its impact on melting or fluid temperatures.


F. As admitted by the Examiner, Kober, et al., fail to overcome the deficiencies of Benner.

The Examiner does not dispute that Kober, et al., say nothing about its impact on melting or fluid temperatures.

Based upon the foregoing, Appellant respectfully requests the Board to reverse the Examiner's rejection of all pending claims and to pass the above-identified patent application to issuance.

Respectfully submitted,

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